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COMPOSITION OF FLOUR FROM THE 1948 POTATO CROP

By R. H. Treadway, C. O. Willits, E. G. Heisler, L. R. Ross,
and Madelyn F. Osborne

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INTRODUCTION

During 1948 and 1949, the Commodity Credit Corporation of the United States Department of Agriculture procured 348 million pounds of potato flour for the European relief program. The normal consumption of potato flour in the United States has been 15 to 20 million pounds a year, and the normal capacity for producing this product has been about 30 million pounds a year. Many companies entered the field of potato flour production for the first time in 1948, and employed a variety of processing methods and equipment. The study reported here was undertaken primarily to obtain data on the composition of potato flour, particularly the ash content, to serve as a basis for Government purchase specifications.

The data on the composition of potatoes grown in various sections of the country should prove of value in their utilization because a large scale examination of potatoes has not been made in recent years, during which time new varieties have predominated. Winton and Winton[1] have compiled extensive data, most of which are at least 50 years old, on the composition of American potatoes. Morrison[2] gives the average composition of 471 samples of potatoes. These samples averaged 21.2 percent total solids, which is considerably higher than the over all average of U. S. potatoes that we have examined in recent years. Because older varieties had higher total solids contents than those grown at present, it is likely that Morrison's samples represent predominantly older varieties. Woodman and Evans[3], recent investigators of the composition of potatoes, have given comprehensive data on British varieties dehydrated in different forms. In 1946 Pavcek et al.[4] reported data on the protein, fat, fiber, ash, carbohydrate (by difference), calcium, phosphorus, and iron in dehydrated products made from California, Idaho, Colorado, Pennsylvania, and Maine potatoes.

SAMPLES

All known producers of potato flour were invited to submit samples for the study. Samples were received from Pennsylvania, Minnesota, Idaho, Nebraska, Washington, Maine, California, Oregon, Maryland, Michigan, Utah, Colorado, Virginia, and New York. One hundred samples were analyzed; 95 were produced

[1] Winton, A. L., and Winton, K. B. The Structure and Composition of Foods. Vol. II, p. 153-170. John Wiley. New York. (1935).

[2] Morrison, F. B. Feeds and Feeding. p. 970. Morrison. Ithaca, N. Y. (1939).

[3] Woodman, H. E., and Evans, R. E., Further Investigations of the Feeding Value of Artificially Dried Potatoes: The Composition and Nutritive Value of Potato Cossettes, Potato Meal, Potato Flakes, Potato Slices, and Potato Dust. Jour. Agri. Sci., 33, 1-14 (1943).

[4] Pavcek, Paul L., and the Committee on Food Composition, Food, and Nutrition Boards, National Research Council, Washington, D. C. Indus. and Eng. Chem., 38, 853-6 (1946).

in commercial plants and 5 in the Eastern Regional Research Laboratory. All potatoes used in making these flours were of the intermediate and late 1948 crop. It was not possible to obtain information on the varieties of potatoes used, but, as a rule either the State or area in which the potatoes were grown was known. Complete information concerning the geographical origin of the potatoes was not always available because mixtures from various States were used. Table 1 shows samples of flour from the major potato-producing areas.

METHODS OF ANALYSES

Total Ash: When both total ash and acid-insoluble ash of potato flour were to be determined, approximately 25 grams of the sample weighed to 0.2 mg. was used. The weighed sample in a 100-ml. platinum dish was charred by heating under a 250 watt infrared lamp, and the ashing was completed in a muffle furnace at 600° C. until constant weight was reached.

Acid-insoluble Ash: The total ash in the platinum dish was digested with 25 ml. of a solution of 1 to 3 hydrochloric acid below the boiling point for 1 hour. It was then filtered through ashless paper and washed three times with 20 ml. of hot water. The filter paper with the insoluble ash was returned to the original dish, charred with the infrared lamp, and ashed to constant weight at 600° C. in the muffle.

Moisture: A 10-gram sample contained in an aluminum dish, 8.5 cm. in diameter, was heated at 130° C. in a mechanical convection oven until constant weight was obtained.

Protein: The method of the Association of Official Agricultural Chemists (A. O. A. C.) for Kjeldahl nitrogen[5], as modified by Willits, Coe and Ogg[6], was used.

Crude Fiber: This analysis was made according to the procedures of the A. O. A. C.[5A] The reader is referred to a recent article on determination of crude fiber in which data obtained by several methods are compared[7].

Crude Fat (ether extract): Procedures of the A. O. A. C. were used for this analysis[5B].

[5] Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists, par. 2.26, p. 27, Ed. 6 (1945). (A) Ibid., par. 27.28, 27.29, and 27.30, p. 408.9; (B) Ibid., par. 27.24 and 27.25, p. 408. (C) Ibid., par. 27.35, p. 411

[6] Willits, C. O., Coe, M. R., and Ogg, C. L. Kjeldahl Determination of Nitrogen in Refractory Materials. J. Assoc. Off. Agr. Chemists. *32*, 118 (1949).

[7] Norfeldt, S., and Svanberg, O. Analysis of Crude Fiber. Acta. Agr. Suecana. *3*, 135-77 (1949) (in English). (C.A. *43*, 7152 (1949)).

Total Assimilable Carbohydrate: Data on carbohydrate content of dehydrated potato products generally give only nitrogen-free extract [100-(% protein + % fat + % crude fiber + % ash + % moisture)], starch plus sugars, or perhaps total hydrochloric acid-hydrolyzable carbohydrate. In this investigation, however, it seemed desirable to determine the carbohydrate as reducing sugars present after enzymatic hydrolysis of the starch followed by acid hydrolysis. This value is considered "total assimilable carbohydrate." It does not include hemicellulose and other nondigestible carbohydrates. A modification of an A. O. A. C. method for determining starch was used[5c].

A 2.5- to 3.0-gram sample of potato flour was digested for 30 minutes at 100° C. and then hydrolyzed by barley malt at 50° to 60°. The hydrolyzate was extracted three times with 75 ml. of distilled water. Protein was removed by lead acetate, and the extract was filtered. The excess lead was removed with sodium carbonate, after which an aliquot of the extract was acid-hydrolyzed, and reducing sugars were determined.

Starch: The method of Steiner and Guthrie[8] was used.

DATA AND DISCUSSION

Table 1 gives analytical data on the 100 samples. Moisture contents of the samples (not included in the table) ranged from 5.8 to 11.4 percent; the average was 8.1 percent.

Table 2 gives the average composition and range in composition of flours produced from potatoes grown in different regions and similar data for the total number of samples. For various reasons, 12 samples were not included in the sectional classifications. In some cases, these few unclassified samples influenced the general averages of the 100 samples considerably. Averages are also given for 96 samples; the values for the 4 flours from ground, pressed potatoes were excluded because pressing removes much of the soluble material.

All data in this discussion are expressed on the moisture-free basis.

Total Ash: The total ash of all samples ranged from 1.43 to 5.96 percent; the average was 4.40 percent. Morrison[2] reported the average total ash content of potatoes as 5.2 percent. The 4 flours produced from ground, pressed potatoes had the lowest ash values, ranging from 1.43 to 2.01 percent. Much of the inorganic salts, soluble protein, and other soluble constituents had been lost in the press juice, and the relative proportions of the insoluble solids had been increased. If these 4 samples and the 5 samples of experimentally produced flour are excluded, the ash of the remaining 91 samples ranged from 2.97 percent to 5.96 percent ash; the average was 4.47 percent.

[8] STEINER, E. T., AND GUTHRIE, J. D., DETERMINATIONS OF STARCH IN SWEET POTATO PRODUCTS AND OTHER PLANT MATERIALS. INDUS. AND ENG. CHEM., ANAL. ED., *16*, 736-9 (1944).

Acid-insoluble Ash: Acid-insoluble ash contents of the 91 samples ranged from 0.01 to 0.70 percent; the average was 0.06 percent. Poorly washed potatoes would be expected to have a relatively large amount of adhering soil, high in hydrochloric acid-insoluble silicious material. We have insufficient information, however, to say that high acid-insoluble ash always denotes inadequate washing. Exclusive of the values of the 2 samples having the highest acid-insoluble ash, 0.70 and 0.43 percent, the average value for the remaining 89 samples was 0.05 percent. The general average for the 100 samples, which included 2 experimentally produced flours made from unwashed potatoes and the 2 commercial samples of extremely high ash content, was 0.07 percent.

Distribution: Table 3 shows the distribution of 94 samples of potato flour with respect to total ash and acid-insoluble ash. These 94 samples do not include the 4 flours produced from pressed potatoes and the 2 flours prepared in this Laboratory from potatoes that were deliberately given inadequate washing. Most samples fell between 3.51 and 5.00 percent in total ash; 13 were above this range, and only 3 were below it. Most of the acid-insoluble ash contents fell within 0.01 and 0.07 percent. In general, samples having low or intermediate total ash contents had low acid-insoluble ash contents. Aside from this, however, there was little correlation between the content of total ash and that of acid-insoluble ash. The 5 flours having highest acid-insoluble ash had intermediate total ash values. The 6 flours having highest total ash had acid-insoluble ash percentages in the low range. All the commercial flours having more than 0.13 percent and about half of those having 0.08 to 0.12 percent acid-insoluble ash were from western states.

Protein: Protein analyses (Kjeldahl nitrogen values X 6.25) of the 100 samples gave values of 3.81 to 13.31 percent; the average value was 10.21 percent. Four samples of flour made from ground, pressed potatoes were abnormally low in protein content, averaging 6.08 percent. If the values for these 4 samples are omitted, the average is increased to 10.38 percent.

Crude Fiber: The crude fiber values for the 100 samples ranged from 0.4 to 4.6 percent; the average was 1.8 percent. The average was increased somewhat by 2 samples that contained 3.5 and 4.6 percent crude fiber; these flours were made from ground, pressed potatoes.

Crude fat (ether extract): The crude fat content of the 100 samples ranged from 0.02 to 0.7 percent; the average was 0.3 percent. Twenty-one of these samples had a crude fat content of less than 0.2 percent, and 18 contained more than 0.4 percent; 61 fell within this range.

Total Assimilable Carbohydrate: These values for the 100 samples ranged from 71 to 84 percent; the average was 78 percent. The average values for the southern and western States were nearly the same; those of the northeastern States were somewhat lower.

Although total assimilable carbohydrate may more nearly represent the true nutritive value of potato flour, data on nitrogen-free extract (N.F.E.), used by some investigators, were also computed for comparison with the total assimilable carbohydrate values. The N.F.E. figures ranged from 78 to 93 percent; the average was 83 percent. This higher value for nitrogen-free extract was expected because it includes hemicellulose and related substances not present in the total assimilable carbohydrate. Some samples, particularly 58 and 59, showed great discrepancies in the two expressions of total carbohydrate. It is believed that the divergence was caused by loss of soluble material during pressing of the potatoes.

Starch: Starch was determined on 10 selected samples of flour made from both peeled and unpeeled and from cooked and uncooked potatoes grown in different sections of the country. Although the average starch content of the uncooked samples was slightly higher than that of the cooked samples (Table 4), there was no indication of extensive conversion to dextrins and other carbohydrates during cooking. Starch values are lower than the corresponding total assimilable carbohydrate values because the latter includes both reducing and nonreducing sugars.

EFFECT OF PEELING POTATOES ON THE ASH CONTENT OF THE POTATO FLOUR

Manufacturers of 33 of the samples did not disclose whether the flours were made from peeled or unpeeled potatoes. Winton and Winton[1] report ash values (moisture-free) for peeled and unpeeled potatoes of 4 and 4.5 percent, respectively.

Snyder, Frisby, and Bryant[9] found that the skin of potatoes contained 9 percent ash (moisture-free basis); the immediately underlying cortical layer, 6.5 percent; the flesh, 4.2 percent, and the whole tubers, 4.8 percent. The ash contents of the skin and cortical layer increase the ash content of the whole tuber only 0.6 percent above that of the interior portion because the high ash fractions are a minor part of the entire potato. Although it would have been desirable to know whether our samples had been produced from peeled or unpeeled potatoes, the effect of peeling on the ash content was perhaps smaller than that of other factors, for example, variety and geographical location. Then too, the amount of residual skin left after peeling may vary over a wide range because several methods of peeling are employed.

The 30 commercial flour samples produced from peeled potatoes averaged 4.39 percent total ash and 0.04 percent acid-insoluble ash. The 32 commercial flours produced from unpeeled potatoes averaged 4.17 percent total ash and 0.05 percent acid-insoluble ash. If 3 samples of flour produced from unpeeled, ground, pressed potatoes are not considered, the average total ash

[9] SNYDER, H., FRISBY, A. J., AND BRYANT, A. P. LOSSES IN BOILING VEGETABLES AND THE COMPOSITION AND DIGESTIBILITY OF POTATOES AND EGGS. U. S. OFFICE EXPT. STA. BULL. 43. 31 PAGES. (1897).

for unpeeled potato flour is increased to 4.42 percent, virtually the same as that for peeled potato flour. The group of 33 commercial samples that consisted of flours from peeled and unpeeled potatoes had average values of 4.53 percent for total ash (ranging from 2.97 to 5.96 percent) and 0.08 percent for acid-insoluble ash (ranging from 0.01 to 0.70 percent). The fact that the acid-insoluble ash of the flour from unpeeled potatoes is nearly the same as that of flour produced from peeled potatoes suggests that the unpeeled potatoes were well washed.

In grinding dehydrated, unpeeled potatoes to flour, usually by a hammer mill, the skin resists pulverizing more than the dehydrated potato flesh does. Therefore a larger proportion of skin tissue, which contains more ash, goes into the coarse fraction than into the fine material. Samples of flour made in one plant contained 1.43 percent total ash in the fine fraction, 1.84 percent in the medium fraction, and 2.01 percent in the coarse fraction.

SUMMARY

One hundred samples of flour produced from the intermediate and late 1948 crop of potatoes from the principal producing areas were analyzed. Moisture contents ranged from 5.8 to 11.4 percent; the average was 8.1 percent. Total ash of all samples ranged from 1.43 to 5.96 percent, (moisture-free basis); the average was 4.40 percent. Most of the samples (78 percent) contained between 3.5 and 5 percent total ash.

Flours with the lowest ash contents were produced from ground, pressed potatoes; loss of much of the inorganic salts in the press juice may account for the low ash content.

Hydrochloric acid-insoluble ash contents of the potato flours ranged from 0.01 to 0.70 percent; the average was 0.07 percent. Most of these values fell within 0.01 and 0.07 percent. There was little correlation between the content of total ash and that of acid-insoluble ash.

The average contents of total ash and acid-insoluble ash were nearly the same for flours from unpeeled and peeled potatoes, a finding which suggests that variety and geographical origin of potatoes may be more important factors than the presence or absence of skin.

Total assimilable carbohydrate contents of the 100 samples ranged from 71 to 84 percent; the average was 78 percent. Nitrogen-free extract contents (computed) ranged from 78 to 93 percent; the average was 83 percent.

Starch determinations showed only slight differences in flours made from cooked and uncooked potatoes, indicating no extensive conversion to dextrins and other soluble carbohydrates during cooking.

Protein contents ranged from 7.81 to 13.31 percent; the average value was 10.21 percent.

Crude fiber contents for the 100 samples ranged from 0.4 to 4.6 percent; the average was 1.8 percent.

Crude fat (ether extract) contents ranged from 0.02 to 0.7 percent; the average was 0.3 percent.

The average potato flour contained 8.1 percent moisture and the following constituents (moisture-free basis): 78 percent total assimilable carbohydrate, 4.40 percent total ash, 0.07 percent hydrochloric acid-insoluble ash, 10.21 percent protein, 1.8 percent crude fiber, and 0.3 percent crude fat.

ACKNOWLEDGMENT

The cooperation of potato flour manufacturers and of the Chemical Engineering and Development Division of this Laboratory in supplying samples and information concerning their processing methods is gratefully acknowledged. The interest and assistance of E. Yanovsky during this study is greatly appreciated.

TABLE I

Composition of potato flours

(moisture-free basis)

Sample No.	Geographical origin of potatoes	Treatment of Potatoes	Total assimilable carbohydrate (As reducing sugars), %	Nitrogen-free extract, %	Protein (NX6.25), %	Total ash, %	Acid-insoluble ash, %	Crude fiber, %	Crude fat, %
1	Virginia, North Carolina	Unpeeled	80	83	11.31	4.31	0.01	1.2	0.1
2	Virginia, North Carolina	do	81	83	10.94	4.21	.03	1.3	.1
3	Virginia	do	79	83	11.06	4.27	.01	1.6	0.3
4	North Carolina, Virginia, New Jersey, Maryland	do[1]	77	82	11.38	4.29	.03	2.2	0.3
5	Virginia	do	80	81	11.75	4.47	.02	2.2	0.2
6	Maryland, Virginia, New York, North Carolina	do[1]	78	81	11.69	4.60	.02	2.5	.2
7	Virginia, Maryland, North Carolina	do	73	82	11.50	4.31	.01	2.1	0.3
8	New Jersey, Maryland, Virginia	do[1]	76	82	11.00	4.81	.05	1.9	0.2
9	New York	do	77	82	11.44	4.68	.03	2.1	0.3

10	New York, New Jersey	do	78	83	10.88	4.46	.02	1.9	0.2
11	New York	do	78	83	10.94	4.36	.02	1.4	.1
12	do	do	77	83	10.81	4.24	.02	1.5	0.3
13	do	do	77	83	11.19	4.52	.13	1.4	.1
14	do	do	75	83	10.75	4.58	.12	1.5	0.2
15	New York, New Jersey	do	78	83	10.81	4.41	.10	1.5	0.2
16	do	do	78	82	11.50	4.59	.06	1.7	.3
17	do	do	75	82	11.69	4.49	.07	1.6	.2
18	New York	do	75	82	11.38	4.43	.06	2.2	.2
19	do	do	82	83	10.88	4.32	.06	1.6	.2
20	do	do	78	82	11.31	4.60	.08	1.6	.2
21	New York New Jersey	do	78	82	11.44	4.52	.09	1.8	.2
22	New York	do	77	83	11.06	4.34	.06	1.7	.3
23	do	do	78	83	10.81	4.30	.07	1.6	.2
24	Minnesota, North Dakota	Peeled	78	86	8.63	3.56	.04	2.0	.3
25	do	do	77	85	9.56	3.29	.03	1.7	.2
26	do	do	81	84	9.75	4.14	.01	1.6	.3
27	do	do	82	84	9.56	4.36	.01	2.0	.4
28	Idaho	do	75	83	9.81	4.11	.02	2.0	.7

TABLE I - continued

Sample No.	Geographical origin of potatoes	Treatment of Potatoes	Total assimilable carbohydrate (As reducing sugars), %	Nitrogen-free extract, %	Protein (NX6.25), %	Total ash, %	Acid-insoluble ash, %	Crude fiber, %	Crude fat, %
29	Idaho	Peeled	81	84	10.38	3.86	.06	1.8	.4
30	New Jersey	Unpeeled[2]	71	81	11.44	5.15	.15	2.4	.1
31	Pennsylvania	Peeled[2]	78	80	13.31	4.36	.02	2.3	.1
32	Colorado	do	77	84	10.13	4.69	.02	1.1	.2
33	do	do	76	80	12.75	5.47	.02	1.5	.5
34	do	do	79	84	9.00	4.96	.17	1.4	.3
35	do	do	77	84	10.06	4.85	.10	1.0	.6
36	do	do	79	83	10.00	5.25	.06	1.6	.2
37	Nebraska	do	74	83	10.56	4.62	.02	1.7	.5
38	Colorado	do	76	83	11.19	4.38	.04	1.7	.1
39	do	do	76	81	11.31	4.98	.04	1.8	.6
40	do	do	82	82	11.19	4.95	.09	1.4	.7
41	do	do	81	81	11.38	5.41	.11	2.1	.6
42	do	do	78	81	12.00	4.58	.07	1.8	.3
43	do	do	79	82	11.44	4.67	.01	1.5	.1
44	do	do	81	83	10.88	4.55	.02	1.6	.4

45	do	do	76	83	11.00	4.12	.06	1.8	.1
46	do	do	80	84	11.13	3.95	.03	0.9	.5
47	Idaho	do	78	84	10.06	3.72	.01	1.4	.5
48	do	do	77	85	10.13	3.79	.01	0.8	.3
49	do	do	80	86	8.63	3.78	.01	1.4	.5
50	do	do	80	86	8.94	3.84	.01	0.4	.7
51	New Jersey	Unpeeled[2]	78	80	10.88	5.29	.38	3.4	.5
52	do	do[2]	78	80	11.81	5.43	.67	2.3	.4
53	do	do[2]	76	81	11.44	5.08	.06	1.9	.6
54	Western	do	81	84	9.50	4.34	.05	1.9	.3
55	do	do	77	84	8.75	4.80	.03	1.9	.4
56	do	do	79	84	9.25	4.89	.12	1.8	.4
57	Eastern	Unpeeled[3]	84	93	3.81	1.43	.04	2.0	.2
58	do	do[3]	74	88	6.44	1.84	.04	3.5	.4
59	do	do[3]	71	86	6.88	2.01	.04	4.6	.5
60	do	do[3]	81	88	7.19	3.09	.03	1.7	.3
61	Western	do	80	85	8.75	4.18	.11	1.6	.1
62	do	do	76	85	9.31	4.26	.03	1.6	.2
63	do	do	77	84	9.75	4.42	.03	1.6	.1
64	do	do	76	84	9.50	4.27	.04	1.9	.2

TABLE I - Continued

Sample No.	Geographical origin of potatoes	Treatment of Potatoes	Total assimilable carbohydrate (As reducing sugars), %	Nitrogen-free extract, %	Protein (NX6.25), %	Total ash, %	Acid-insoluble ash, %	Crude fiber, %	Crude fat, %
65	Western	Unpeeled	80	85	8.81	4.66	.70	1.7	.3
66	do	do	78	85	8.81	4.72	.04	1.7	.1
67	do	do	79	85	8.75	4.79	.43	1.7	.3
68	Idaho	Peeled	81	86	8.75	3.59	.01	1.4	.1
69	do	do	84	87	8.19	3.79	.04	1.1	.1
70	Western	do	82	85	9.13	4.11	.04	1.7	.3
71	Maine	do	78	82	11.25	4.64	.03	1.7	.3
72	do	do	75	81	12.13	4.84	.02	1.6	.3
73	do	do	74	82	12.06	5.05	.02	1.2	.2
74	Western	do	84	87	7.75	3.72	.06	1.6	.02
75	do	do	81	87	7.13	3.83	.11	1.7	.1
76	do	do	79	84	9.94	4.49	.06	1.7	.2
77	do	do	79	84	9.69	4.48	.08	1.7	.2
78	do	do	78	83	9.63	5.08	.03	1.7	.2
79	do	do	77	83	9.94	5.08	.02	1.7	.2

80	do	do	75	82	9.69	5.11	.02	2.8	.2
81	Eastern	Unpeeled	76	82	11.25	4.52	.07	1.8	.2
82	do	do	79	82	11.19	4.54	.05	2.0	.1
83	Western	do	79	83	9.88	4.93	.05	2.1	.3
84	do	do	79	82	10.06	4.71	.07	3.4	.2
85	do	do	79	85	7.94	4.52	.02	2.2	.1
86	Eastern	do	73	80	12.50	5.27	.04	2.0	.2
87	do	do	74	80	12.25	5.35	.02	2.3	.2
88	Western	do	82	84	9.25	4.21	.02	2.1	.3
89	do	do	80	83	9.69	4.27	.04	2.6	.3
90	do	do	80	84	10.19	4.05	.04	1.7	.4
91	do	do	80	85	8.81	4.19	.02	1.5	.3
92	do	do	71	78	13.31	5.96	.02	2.3	.4
93	do	do	84	82	10.94	4.83	.02	2.3	.3
94	do	do	83	83	9.50	5.57	.04	2.2	.3
95	do	do	78	83	11.00	4.20	.05	2.0	.1
96	do	do	76	85	9.56	3.17	.01	1.7	.2
97	do	do	75	85	10.56	2.97	.05	.9	.2
98	do	do	82	84	9.25	4.58	:08	1.7	.1

TABLE I - continued

Sample No.	Geographical origin of potatoes	Treatment of Potatoes	Total assimilable carbohydrate (As reducing sugars), %	Nitrogen-free extract, %	Protein (NX6.25),[1] %	Total ash, %	Acid-insoluble ash, %	Crude fiber, %	Crude fat, %
99	Western	Unpeeled	81	85	8.44	4.54	.04	1.7	.1
100	do	do	81	84	8.88	4.74	.07	2.0	.2

[1] *Potatoes from mixed areas.*

[2] *Experimentally produced flour.*

[3] *Pressed potatoes.*

TABLE 2

Average composition and range of composition of flours produced from potatoes grown in various areas (Moisture-free basis)

Area	Assimilable carbohydrate, %	Protein (NXG.25), %	Total ash, %	Acid-insoluble ash, %	Crude fiber, %	Fat, %
Northeastern States (22 samples) [a]	77 (73 to 82)	11.24 (9.56 - 12.50)	4.46 (2.97 - 5.35)	0.05 (0.01 - 0.13)	1.7 (0.9 - 2.3)	0.1 (0.1 - 0.3)
Southern States (7 samples) [b]	78 (73 to 81)	11.29 (10.94 - 11.75)	4.38 (4.21 - 4.54)	.03 (0.01 - 0.07)	1.7 (1.2 - 2.2)	.2 (0.1 - 0.3)
Western States (59 samples) [c]	79 (71 to 84)	9.44 (7.94 - 13.31)	4.47 (3.29 - 5.96)	.06 (0.01 - 0.70)	1.7 (0.4 - 3.4)	.3 (0.0 - 0.7)
Average of total (100 samples) [d]	78 (71 to 84)	10.21 (3.81 - 13.31)	4.40 (1.43 - 5.96)	.07 (0.01 - 0.70)	1.8 (0.4 - 4.6)	.3 (0.0 - 0.7)
Average of 96 samples [e]	78 (71 to 84)	10.38 (7.13 - 13.31)	4.50 (2.97 - 5.96)	.07 (0.01 - 0.70)	1.8 (0.4 - 3.4)	.3 (0.0 - 0.7)

[a] *Produced chiefly from Me., Pa., N. Y., and N. J. potatoes.*

[b] *Produced from Va., Md., and N. C. potatoes.*

[c] *Produced in Mich., Minn., Neb., Colo., Utah, Ida., Ore., Wash., and Calif.*

[d] *Includes 12 samples not given in sectional classification produced from potatoes from mixed areas, experimentally produced flours, and flours produced from ground, pressed potatoes.*

[e] *Excludes 4 flours made from ground, pressed potatoes.*

TABLE 3

Distribution of 94 samples of potato flour

with respect to total ash and acid-insoluble ash contents

Total ash content[1]		Acid-insoluble ash content[1], %, of -			
%	Number of samples within range	0.01 - 0.07	0.08 - 0.12	0.13 - 0.15	Above 0.15
		(Number of samples within range having total ash values within range shown in first column)			
2.97 - 3.50	3	3	0	0	0
3.51 - 4.00	11	10	1	0	0
4.01 - 4.50	34	31	3	0	0
4.51 - 4.75	22	16	4	1	1
4.76 - 5.00	11	6	3	0	2
5.01 - 5.25	7	6	0	1	0
5.26 - 5.50	4	3	1	0	0
5.51 - 5.96	2	2	0	0	0
	Total	77	12	2	3

[1] *Moisture-free basis.*

TABLE 4

Starch contents of selected samples

of potato flours

Sample No.	Geographical origin of potatoes	Peeled or unpeeled	Cooked or uncooked	Starch,[1] %
1	Virginia and North Carolina	Unpeeled	Cooked	71
26	Minnesota and North Dakota	Peeled	do	71
34	Colorado	do	do	75
37	Nebraska	do	do	69
47	Idaho	do	do	76
49	do	do	do	76
71	Maine	do	Uncooked	74
74	Western	--	do	79
88	do	--	do	74
98	do	Unpeeled	do	73

[1] *Moisture-free basis.*